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Financing Education Abroad: A Developing Country Perspective

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Gega Todua†

Abstract

Developing countries intensively promote education abroad through financial aid policies. While some financially support students with scholarships, other countries prefer to provide loans. This paper provides a novel data-set containing characteristics of world-wide government-funded scholarship and loan programs supporting education abroad. The data allows us to identify unique stylized facts on these financing policies for middle and low income countries. We find that scholarship programs more frequently select students based on merit criteria, target graduate and postgraduate study level, and require recipients to return after studies than loan programs do. We build a two-country student migration model with government intervention to qualitatively account for the observed patterns. In our model, government intervention is justified for two reasons. First, students from a developing country are financially constrained and cannot afford education abroad. Second, the government values the productivity of "returnees" higher than the market does. We argue that when students are uncertain about their future productivity and may fail at their studies, scholarship programs can insure them against potential default. Consequently, if students differ in their expected ability, under certain conditions a government with a tight budget will prioritize ex-ante high-ability students and support them with scholarships with the return requirement, and support ex-ante low-ability students with loans without the return requirement.

JEL codes: F22, H52, O15
Keywords: Student Migration; International Migration; Higher Education Policy; Social Welfare

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1 Introduction

Governments in developing countries often play a critical role in supporting university education abroad for their citizens by using financial aid programs. Economic literature emphasizes two possible reasons that can motivate governments in developing countries to promote education abroad. First, poor individuals from the developing world do not always have access to credit markets (Banerjee 2003; Dustmann and Okatenko 2014). Second, governments might expect a positive externality ("multiplier effect") from study abroad alumni who return to their home countries (DAAD and British Council, 2014). External economic and non-economic benefits for the sending countries might include R&D spillovers (Le 2010), fostered democracy in the home country (Spilimbergo 2009), human rights development (Atkinson 2010), and better inter-cultural understanding (Edelstein and Douglass 2012). According to standard economic theory, for these two reasons the level of foreign education attainment in the source country will be lower than the socially optimal one and thus government intervention is needed.

Two major financial aid programs promoting higher education abroad have been prevalent: international scholarships and loan programs. International scholarship programs have existed since the early 20th century, when several countries created programs to train the administrative elite of their colonies. Until the 1990s, generally only developed countries operated and funded international scholarship programs (Varghese, 2008). Since then, however, former Soviet countries have been offering more opportunities for their citizens' education abroad. In addition, over the last five years, a new wave of international scholarship programs have emerged in Latin America and Asia that are continuously expanding (Perna et al. 2014). At the same time, large-scale loan programs have been operating in several developed countries for many years (e.g. Bafog in Germany). Some developing countries have also administered loan programs that send students abroad. One well-established example is a government-sponsored student loan scheme in Mauritius (UNESCO, 2006).

This paper makes two contributions to the literature. First, via Internet search, we collect a novel data-set on government-funded scholarship and loan programs that send students abroad. The collected data-set has an advantage over all previous available data because it allows us to identify unique stylized facts for scholarship and loan programs for middle and low income countries.[1] In particular, we find that the scholarship programs more frequently have an academic merit requirement, target graduate/postgraduate education, and require recipients to return to their home country than the loan programs do.[2]

[1] See appendix A for definitions of middle and low income countries, in addition to other key terms used throughout the paper. We use term "middle and low income country" to refer to a developing country.

[2] There are possible alternative approaches to using the data in the research. Firstly, one can empirically investigate what the characteristics of countries that administer loans or scholarships are. Such an analysis might provide insight about the determinants of a government's choice to opt for one type of financial aid over another. Secondly, the data can be complemented by policies from developed countries. Such a combination can provide a more general picture of the market of "international talent," in which developed countries lay down policies to attract international students from developing countries and developing countries promote their citizens' education abroad.

Second, we build a two-country student migration model with government intervention to qualitatively explain the observed patterns. We analyze the model in which students from a developing country cannot finance their education abroad and the government expects a positive externality from study abroad graduates who return to the sending country upon graduation. Within this environment, we show that uncertainty about individual ability and the possibility that students may fail at their studies are crucial factors that generate the stylized facts. Specifically, when making education decisions, students cannot perfectly evaluate their own ability, and risk failure in university studies. The students learn about their ability, and thus their productivity, only when they graduate and become employed. Consequently, when the degree of uncertainty is sufficiently high, the likelihood of loan default becomes large and students will never accept loans. We demonstrate an example with two ex-ante ability groups of students where the government prioritizes ex-ante high-ability students and supports them with scholarships with the return requirement, and supports ex-ante low-ability students with loans without the return requirement. Our described theoretical environment in which students are uncertain about their own ability is novel in the migration literature.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 discusses the methodology of the data collection and establishes stylized facts. Sections 4 builds the model to qualitatively account for the stylized facts. Section 5 concludes and points out further directions of the research.

2 Related Literature

Few studies analyze government-funded financial aid programs designed to promote education abroad for developing countries. Limited insights about the features of programs financing education abroad can be gleaned from OECD, UNESCO, and the World Bank reports, as well as several case studies, e.g. Woodhall (1992), Salmi (2003), The International Comparative Higher Education Finance and Accessibility Project (2009), Devesa and Blom (2007), Shen and Ziderman (2009), Ziderman (2013). However, these studies either only consider programs that support domestic university studies or provide a comparison of programs in selected countries.

Nevertheless, recent studies by DAAD[3] and British Council (2014) and Perna et al. (2014) are relevant. DAAD and British Council (2014) analyze scholarship programs in 11 selected countries (including both developed and developing countries). The study finds that scholarship programs tend to support graduate studies and are likely to have some merit criteria in the selection of recipients.

Perna et al. (2014) provide a typology summarizing programmatic indicators of active government-funded scholarship programs over the world. The report uses data collected via Internet search in 2014 and classifies scholarship programs with respect to degree, priority fields, types of expenses covered (full or partial), destination restriction, and return

[3]DAAD is the German Academic Exchange Service.

obligation. The study finds that of government-funded programs promoting education abroad, 63% promote graduate/postgraduate degrees and 25% oblige recipients to return after studies.

Although these studies describe various characteristics of scholarship programs, neither provides sufficient information on loan programs nor allows to carry out a comparative analysis of the types of financial aid programs. Our novel data-set fills this gap in the literature as it documents characteristics of both types of financial aid programs: loans and scholarships. Furthermore, the data-set allows us to establish unique stylized facts for middle and low income countries that were not available before.

With regard to the theoretical literature, the only study that explicitly examines the optimal financial aid policy promoting education abroad is by Franck and Owen (2015). They investigate the performance of different types of grants in a two-country model with an education quality differential, endogenous probability of migration, and students' heterogeneity in ability. The government maximizes aggregate welfare generated only by the citizens of the country subject to the exogenous budget constraint. Their paper compares three types of grant schemes: unconditional grants, conditional grants with return requirement, and grants with operating return.[4] As Franck and Owen (2015) find, the optimal financial aid policy for a government with a tight budget is the grant with operating return. The authors also conjecture that when ability is the students' private information and not observed by the government, loans with the return requirement will be an optimal policy. This prediction follows from their model in which students perfectly know their own ability, and consequently, their future wages. In such a case, highly able students would know that they will earn enough to repay the loan after their studies. Therefore, only these students will be willing to accept loans and the government with a limited budget will maximize its expected welfare.

Other studies investigate different aspects of student migration. Rosenzweig (2008) and Driouchi (2014) analyze a two-country student migration model and find that education quality and skill premium differentials might be most influential factors inducing outmigration of students from lower income countries. Haupt et al. (2010) find that the positive probability of permanent migration, when this probability is sufficiently moderate, raises the aggregate human capital of a sending country.

Our model differs from the above models in various dimensions. First, neither of these models imposes any market imperfection, while we analyze a model in which students cannot finance their education abroad and there is a positive externality coming from returnees. Second, all these models assume that individual ability is the private information of students, while we introduce uncertainty about own ability and the stochastic return to education abroad (with possibility of failure). Third, these models assume that the return migration decisions of students are exogenous, while we allow for endogenous decision on return migration. Therefore, our model is significantly richer compared to the existing

[4]Unconditional grants do not oblige the grant recipients to return to the home country after their studies abroad; conditional grants with return requirement require recipients to return after studies; and grants with operating return allow recipients to stay abroad if they repay the amount of the grant to the government.

models.

Our study is also related to Kwok and Leland (1982), Lien (1993), and Dai et al. (2015), who investigate the effect of return subsidies on the welfare (or the average productivity of workers) of a source country. These models assume that students decide to pursue education abroad and to return upon graduation based on a cost-benefit analysis. In addition, these models allow for information asymmetry such that the firms do not perfectly recognize the true productivity of workers. Still, neither of these papers explicitly examines the optimal financing policy for sending students abroad.. In addition, the information asymmetry presented in our paper differs from the above authors' specification. In particular, we assume that both students and government are uncertain about individual ability at the initial stage, while their models assume that ability is the private information of a student.

Our work is also related to Vidal (1998) and Stark and Zakharenko (2012), who analyze migration from developing countries with externality related to education attainment, and to Dustmann and Okatenko (2014), who consider financial constraints as obstacles to outmigration.

Lastly, our model is part of the large strand of "brain drain" literature extensively developed since Bhagwati and Hamada's (1974) seminal paper. The conventional assumption in this particular literature is that the government of a sending country maximizes the welfare (or average or aggregate productivity) of citizens that permanently reside in the source country, e.g. Stark et al. (1997, 1998), Stark and Wang (2002), Docquier and Rapoport (2008), Eggert et al. (2010). Our model diverges from this specification and provides a more general form of the government objective that potentially includes the welfare of permanent migrants.

3 The Data

3.1 Methodology

The methodology of the data collection is adopted from Perna et al. (2014). During January-May, 2015, we used a systematic Internet search to identify federal or government scholarship and loan programs supporting postsecondary education abroad. We limited the population to education loan and scholarship programs that are (fully or partially) financed by the national or federal governments in 196 independent states identified by the U.S. Department of State (Bureau of Intelligence and Research 2014).

To collect the data, we first searched through the English versions of government websites (government, ministry of higher education) for each country. Second, we investigated several reports and case-studies to glean information about existing programs (i.e. UNESCO (2011), the World Bank (2010), Mapping European Union Member States Higher Education External Cooperation Programmes and Policies (2010), The International Comparative and Higher Education Project (2009), National Student Fee and Support Systems

in European Higher Education (2011-2015), Celik (2009), Lam and Oste (2014)). Third, we conducted web-searches in English and the national language of the country for several key-word combinations containing country name and variation(s) of words referring to financial aid.[5] National languages were identified from the U.S. Central Intelligence Agency (2013). Google Translate was used if necessary.

Whenever we identified a web source containing information regarding education financial aid, we saved the web-address and analyzed the information. We restricted our focus to only scholarship and loan programs that target higher education abroad. These programs consist of scholarships and loans that exclusively promote education abroad, as well as programs that encourage tertiary education both locally and abroad. Programs that promote higher education only domestically were excluded. In addition, we only focused on programs that are fully or partially funded by national public resources, i.e. financed by a government authority. As for loan programs, in addition to programs fully administered and financed by a government (Federal Direct Subsidized Stafford Loans, Ministry of Education and Scientific Research loan in Mauritius), we included private loans subsidized or secured by a government (Government Supported Education Loans in Russia, Padho Pardesh in India). Loan or scholarship programs that operate using only private resources or funds established on the basis of intra-governmental agreements were excluded from our analysis.

To check whether a program satisfied the above criteria, we explored whether the program was mentioned on government websites and if either "government" or "public fund" was primarily stated in the source. We also checked whether it was clearly stated that financial aid can be used for education abroad.

For each program we recorded several available characteristics. Variables were systematically organized in Excel and filled in manually from the websites. A full list of the variables is presented in Appendix C. The full data-set is available upon request.

It is important to note that the collected data might not represent the whole population of policies. First, the population of programs might be at risk of selection bias, as it only documents financial aid programs that were available through the Internet January-May, 2015. Second, the data may not include full information on the characteristics of each program, as in some cases a limited number of indicators were available on the Internet.

Despite these limitations, the current data-set represents the best available data-set on the characteristics of financing programs supporting education abroad. The full list of countries with scholarship and loan programs is presented in Tables 3-5 in appendix D.

Table 1: Stylized Facts on Financial Aid Programs for Middle and Low Income Countries.

Fact 1	Scholarship programs *more frequently* select students based on *merit criteria* than loan programs do.
Fact 2	Scholarship programs are *more likely* to promote *graduate/postgraduate studies* than loan programs.
Fact 3	Scholarship programs are *more likely* to *require recipients to return* after completion of studies than loan programs.

3.2 Data Analysis and Stylized Facts for Middle and Low Income Countries

In total, we document 76 government-funded programs that promote education abroad in middle and low income countries, of which 51 are scholarship programs and 25 are loan programs. To establish stylized facts, we count scholarship and loan programs that have merit criteria, are targeted towards graduate/postgraduate studies, and require recipients to return after completion of studies. The facts about government-financed programs promoting higher education abroad are the following:

Fact 1: In middle and low income countries 64.71% of scholarship programs and 48.00% of loan programs select recipients based on merit criteria.

Fact 2: In middle and low income countries 56.86% of scholarship programs and 20.00% of loan programs target graduate/postgraduate education.

Fact 3: In middle and low income countries 54.9% of scholarship programs and 8.00% of loan programs require recipients to return after completion of studies.

The findings are also presented in Table 10 in Appendix D.

The established facts imply that scholarship programs more frequently have academic merit requirements, target graduate/postgraduate studies, and require recipients to return after graduation. Conversely, loan programs are more flexible with respect to the return obligation and less selective regarding academic merit and study level. The stylized facts are summarized in Table 1.

The presented stylized facts contradict some of the theoretical predictions and conventional assumptions of the migration literature. First, the stylized facts counter the theoretical prediction of Franck and Owen (2015) that loans with the return requirement should be an optimal financing policy for a government with a tight budget. The reasoning of their model is that higher-ability students are those who are likely to earn higher wages after studies and to be able to repay the loan amount. Therefore, even if the government does not observe the ability of students, only high-ability people will be willing to accept loans and to repay them upon graduation. Hence, a government with a tight budget would prefer to economize and to finance more students with loans with the return re-

[5] See Appendix B for a full description of the key-word combinations.

quirement. However, according to the stylized facts, countries rarely use loans with the return requirement. In addition, according to stylized facts 1 and 2, loan programs seem to be more flexible and less oriented towards "high-ability" students than conjectured by Franck and Owen (2015).

Second, our findings suggest that in reality government's objective is at variance with the conventional "brain-drain" objective. According to the traditional "brain-drain" approach, government's objective contains only the welfare/productivity of the residents. Consequently, government considers permanent migrants a waste of its human capital. If the "brain-drain" model were true, one should expect that countries frequently require their citizens to return after studies. However, according to Table 10, nearly 60% of total policies in middle and low income countries do not require recipients to return after completion of studies. This can imply that government's objective in reality is flexible with regard to the post-study residence of students.

One of the shortcomings of our interpretation of the stylized facts is that our descriptive analysis simply counts existing programs and does not weigh them based on the expenditure or the size of programs. Thus, the large scholarship programs, e.g., Brazil's, is treated as equivalent to small programs, e.g. the loan program in Mauritius. We omit the dimension of size because of the large number of missing observations on the program budgets. Omitting the size of programs could create a potential problem, particularly if the size of the program is correlated with the type of program (scholarship vs. loan). Nevertheless, throughout the paper we assume no correlation between the size and the type of a program.

In addition, we abstract from interpreting the financial aid policies in middle and low income countries as being a response to developed country policies promoting incoming student mobility from developing countries. Although such an interpretation is quite realistic, this chapter starts with the simplest scenario and studies only a sending country dimension in which the receiving country is inactive. Future research could aim to investigate a more general picture where both developed and developing countries play actively in the "market" for international students.

The presented stylized facts serve as the motivation to build a student migration model that can qualitatively account for these stylized facts. Section 4 develops the framework for the model.

4 The Model

We develop a model which can qualitatively account for the stylized facts. The assumption we impose is that the stylized facts are the result of the government maximization problem of aggregate social welfare. First, we develop a basic model of student migration. Next, we extend the basic model and identify the ranges for the parameter values that generate stylized facts.

4.1 The Basic Model Without Government Intervention

There are two countries: home and foreign. The home country is a developing country and the foreign country a developed country. The home country is populated with a mass of students who have an initial level of endowment $I \geq 0$. Acquiring education is only possible in the foreign country and the cost of education attainment is $c > 0$ for all students. The education cost encompasses all types of economic and psychological fixed costs related to studying abroad, which in general can be higher than pure tuition fees.

Students in the home country are characterized with an initial level of ability, productivity, or human capital (θ). The value of θ is randomly drawn from a uniform distribution with an expected value $\mathbb{E}(\theta)$ and the degree of uncertainty or the spread of distribution $\phi = \frac{\overline{\theta}}{\underline{\theta}} - 1$ where $\overline{\theta}$ and $\underline{\theta}$ stand for the upper and lower bounds of the distribution, respectively. Initially, the students cannot perfectly evaluate their own ability and only know the values of $\mathbb{E}(\theta)$ and ϕ that are public information and the same for all students.[6] The productivity is revealed only after all migration decisions are settled (details about the timing are described below).[7]

Students are also described with parameter x that stands for disutility from loan default. Specifically, if a student accepts a loan and defaults, she experiences x amount of disutility. There is γ_x fraction of students with $x = 0$ and $(1 - \gamma_x)$ fraction of students with $x = \overline{x} > c$. The value of x is a student's private information.

The model without government intervention is as follows. There are two periods in the model. In the first period, persons in the home country decide between acquiring education in the foreign country or staying in the home country. The education enhances the human capital by factor μ and the expected ability becomes $\mu\mathbb{E}(\theta)$. Factor μ is a random variable and

$$\mu = \begin{cases} \overline{\mu} & \text{with probability} \quad (1-\pi) \\ 1 & \text{with probability} \quad \pi \end{cases} \tag{1}$$

where $\overline{\mu} > 1$ and $\pi \in (0, 1]$. Alternatively, with probability π a student fails during her studies and ends up with the initial level of her (expected) human capital. When deciding upon education, students only know about the distribution of μ.

At the beginning of the second period, after studies are over, the value μ is revealed. If a student fails during her studies ($\mu = 1$), she has to return to the home country and work

[6] According to our specifications, given ϕ a higher expected value of ability $\mathbb{E}(\theta)$ implies a higher range of the distribution of θ in absolute terms. That is $\overline{\theta} - \underline{\theta} = \frac{2\mathbb{E}(\theta)\phi}{\phi+2}$ which is increasing in $\mathbb{E}(\theta)$). This assumption can be motivated such that high-ability students have a larger range of opportunities in employment than the low-ability ones - starting from average-paid qualifications to top managers, CEO, etc. Low-ability students usually have comparably limited prospects on the labor market and a smaller range of available earnings.

[7] In other words, students are ex-ante homogeneous in their expected productivity. However, they are ex-post heterogeneous once the value of θ is revealed. The scenario in which students are also ex-ante heterogeneous is analyzed in section 4.2.

there. If a student successfully graduates ($\mu = \overline{\mu}$), she decides to migrate home or to stay abroad. If this graduate returns to the home country, the human capital is depreciated by β ($\beta < 1$ and $\beta\overline{\mu} > 1$) and the expected productivity becomes $\beta\overline{\mu}\mathbb{E}(\theta)$.[8] If this student decides to remain in the foreign country, she has to pay a living cost abroad, which can be considered an opportunity cost of the time spent to socialize with family and friends who remain in the home country.[9] The living cost abroad of a student is assumed to be m fraction of her earnings where $m > 0$.

Once decisions on return migration are settled, the ability θ becomes publicly observable. Labor markets in both countries are perfectly competitive. As soon as θ is revealed, employment occurs at the place of a student's residence. Since the uncertainty about ability is resolved, firms can perfectly observe the human capital of workers and offer them wages equal to their revealed productivity. Therefore, from the firms' point of view there is no uncertainty about workers' productivity whatsoever.

Given the environment, we assume two types of market imperfection that justify government intervention.

Assumption 1. *Students are financially constrained ($I < c$) and unable to borrow.*

Since the home country is from the developing world, it is natural to assume that poor individuals have neither sufficient finances to afford education abroad nor perfect access to credit markets. In the model, we assume an extreme situation in which students are unable to borrow.

Assumption 2. *The social value of returnees' productivity is $\chi > 1$ times the corresponding market value.*

Assumption 2 implies that returnees create a positive externality for the domestic economy. The motivation of assumption 2 is that once graduates from foreign studies return to the home country, the production spillovers occur and are evenly distributed across all sectors of the economy. Since we do not model the production side of the sending country economy, we assume that the government values the productivity of returnees higher than the market does. The parameter χ can be interpreted as the social value of the productivity of returnees.

Finally, we assume no time-discounting and risk-neutral preferences.

4.1.1 The Market Outcome Without Government Intervention

In the first period, subject to the individual budget constraint, students decide to migrate or to stay in the home country. If students were not financially constrained, they would

[8] This is a commonly used approach in the migration literature to model the wage differential between developed and developing countries.

[9] The living cost abroad in the model should not be attributed to the differences in living conditions between developing and developed countries. Such differences are already captured by wages since the model assumes the wages in real terms. Instead, the living cost abroad is an opportunity cost that occurs only during permanent migration and captures an opportunity cost of home-sickness.

decide whether to migrate by comparing the expected utility from acquiring education abroad to the expected utility from staying in the home country. Furthermore, under no financial constraints, students could be classified into three groups:

1. Students for whom it is ex-ante optimal to stay at home (H).
2. Students for whom it is ex-ante optimal to study abroad and return (R).
3. Students for whom it is ex-ante optimal to study and work abroad (F).

Due to the risk-neutral preferences, the corresponding expected utility for each group would be:

$$U^H = I + \mathbb{E}(\theta), \tag{2}$$

$$U^R = I - c + ((1-\pi)\beta\overline{\mu} + \pi)\mathbb{E}(\theta), \tag{3}$$

and

$$U^F = I - c + ((1-\pi)(1-m)\overline{\mu} + \pi)\mathbb{E}(\theta), \tag{4}$$

respectively. Clearly, under no financial constraints a student would choose the population group that would generate the highest expected utility. Specifically, a student would opt to study abroad and return, or choose R, if both her expected ability and the living cost abroad were sufficiently high, that is

$$\mathbb{E}(\theta) \geq \frac{c}{(1-\pi)(\beta\overline{\mu} - 1)} := \hat{e}_1 \ \ \& \ \ m \geq 1 - \beta := \hat{m}. \tag{6}$$

A student would opt to study and remain abroad, or choose F, if her expected ability were sufficiently high and the living cost abroad were sufficiently low, that is

$$\mathbb{E}(\theta) \geq \frac{c}{(1-\pi)((1-m)\overline{\mu} - 1)} := \hat{e}_2 \ \ \& \ \ m < \hat{m}. \tag{7}$$

Finally, a student would never go abroad, or choose H, if her expected ability were not sufficiently high, that is

$$\mathbb{E}(\theta) < min(\hat{e}_1, \hat{e}_2). \tag{8}$$

The privately optimal outcome with no financial constraints for different values of $\mathbb{E}(\theta)$ and m is also illustrated in Figure 1(a).

However, as $I < c$ students stay in the home country and receive U^H.

4.2 The Social Optimum

This section introduces the notion of social welfare for the developing home country. We assume that the aggregate social welfare of the home country includes the welfare of all

citizens irrespective of the place of their residence after studies abroad. This welfare structure is different from the traditional "brain drain" structure. Conventionally, permanent migrants are considered a skill waste for a sending country. Alternatively, the "brain-drain" interpretation of the government objective function is that welfare should include only the welfare of the sending country residents. The reason we model the government objective is two-fold. First, our motivation is driven by the data on government-funded financial aid policies. According to table 10, nearly 60% of financial aid policies in middle and low income countries do not oblige recipients to return after their studies. This implies that in reality governments' objective might be closer to the social welfare definition presented in this paper. Second, our model is more general than the traditional one. In particular, when $\chi\beta > 1$ our model is equivalent to the "brain-drain" model.

The social planner does not observe students' ability θ; rather, it knows only the expected value $\mathbb{E}(\theta)$ and the spread of the distribution ϕ. The social planner also does not observe the cost of loan default x that is the private information of a student. According to assumption 2, the social productivity of returnees is χ times their market productivity. Therefore, the expected welfare for each population group, from the social point of view, is the following:

$$W^H = I + \mathbb{E}(\theta) = U^H, \tag{9}$$

$$W^R = I - c + ((1-\pi)\chi\beta\overline{\mu} + \pi)\mathbb{E}(\theta) > U^H, \tag{10}$$

and

$$W^F = I - c + ((1-\pi)(1-m)\overline{\mu} + \pi)\mathbb{E}(\theta) = U^F. \tag{11}$$

The social welfare from returnees is higher than the expected utility (under no financial constraints) of returnee students by $(\chi - 1)(1-\pi)\beta\overline{\mu}\mathbb{E}(\theta)$ due to externality. Groups H and F do not create any externality and the social welfare coincides with the expected utility (under no financial constraints) from these population groups.

The social planner can simply direct students to one of the groups H, R, F to maximize the aggregate social welfare. The social planner maximizes the aggregate social welfare:

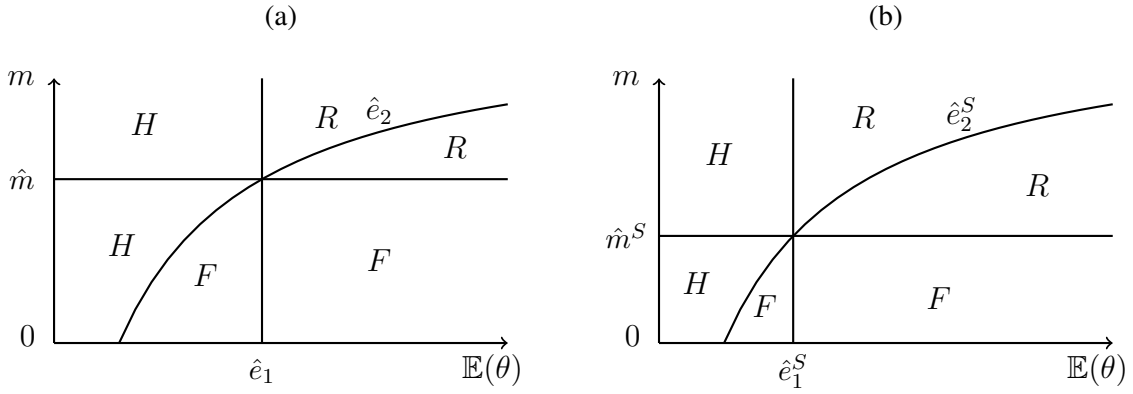
$$\underset{\{D\}}{\text{Max}}\, SW\big(D\big) = W^D \tag{12}$$

where $SW(.)$ stands for the aggregate social welfare and D stands for the population group ($D \in \{\{H\}\{R\}\{F\}\}$). The welfare W^D is determined according to equations (9)-(11).

The socially optimal outcome depends on values that $\mathbb{E}(\theta)$ and m can take on. In particular, the socially optimal outcome is population group R, if, from the social perspective, both the expected ability and the living cost abroad are sufficiently high, that is

$$\mathbb{E}(\theta) \geq \frac{c}{(1-\pi)(\chi\beta\overline{\mu} - 1)} := \hat{e}_1^S \;\; \& \;\; m \geq 1 - \chi\beta := \hat{m}^S. \tag{13}$$

Figure 1: (a) The Privately Optimal Outcome (under no financial constraints); (b) The Socially Optimal Outcome when $\chi \in (1, \frac{1}{\beta})$. It holds that $\hat{m} > \hat{m}^S$, $\hat{e}_1 > \hat{e}_1^S$, and $\hat{e}_2 = \hat{e}_2^S$.



The socially optimal outcome is population group F, if, from the social perspective, students' expected ability is sufficiently high and the living cost abroad is sufficiently low, that is

$$\mathbb{E}(\theta) \geq \frac{c}{(1-\pi)((1-m)\overline{\mu}-1)} := \hat{e}_2^S \ \ \& \ \ m < \hat{m}^S. \tag{14}$$

Finally, the socially optimal outcome is population group H, if, from the social perspective, students' expected ability is not sufficiently high, that is

$$\mathbb{E}(\theta) < min(\hat{e}_1^S, \hat{e}_2^S). \tag{15}$$

The socially optimal outcome for different values of $\mathbb{E}(\theta)$ and m is also illustrated in Figure 1(b).

It is clear that $\hat{e}_1^S < \hat{e}_1$, $\hat{m}^S < \hat{m}$, and $\hat{e}_2^S = \hat{e}_2$. The result is intuitive because the government expects a positive externality from the returnee students ($\chi > 1$). Therefore, the parameter range for which R is the socially optimal group is larger than that for which R is the privately optimal group (with no financial constraints). Specificaly, there is a range of parameters for which it is privately optimal (under no financial constraints) to remain at home (H), whereas due to externality, the socially optimal outcome is R ($\mathbb{E}(\theta) \in [\hat{e}_1^S, \hat{e}_1)$ & $m \geq \hat{m}$). Additionally, there is a range of parameters for which the privately optimal outcome (without financial constraints) is to study and remain abroad (F), whereas due to externality, the socially optimal outcome is R ($\mathbb{E}(\theta) \geq \hat{e}_1^S$ & $m \in [\hat{m}^S, \hat{m})$). For the rest of the cases, the privately (without financial constraints) and the socially optimal outcomes coincide.

4.3 The Government

The government does not observe a student's productivity and only knows about the expected value $\mathbb{E}(\theta)$ and the spread of the distribution ϕ. The government also does not observe the cost of loan default that is a student's private information.

The government is constrained by an upper limit of the budget, denoted by B ($B > 0$).[10] Subject to the budget constraint, the government sets the policy that maximizes the expected aggregate welfare of the society.

Government Policy. The government determines the financial aid policy at the beginning of the first period, before any individual decisions whether to migrate are made. The government policy is comprised of the type of financial aid ($\mathbf{P}$), the return requirement ($\mathbf{r}$), the amount of aid ($\mathbf{a}$), the fraction of applicants receiving aid (α), and the lump-sum transfers distributed at the end of the second period ($\mathbf{G}$). Below we discuss the characteristics of each tool in detail.

The type of policy ($\mathbf{P}$). The government is restricted to choose only one type of policy at once ($\mathbf{P} \in \{\mathbf{P_0}, \mathbf{P_s}, \mathbf{P_l}\}$). The government can either offer a scholarship ($\mathbf{P_s}$), a loan ($\mathbf{P_l}$), or no financial aid at all ($\mathbf{P_0}$).

Scholarships do not require recipients to repay the amount of aid. A loan is aid that should be repaid in the second period after employment occurs (the detailed timing of the model is described below). If a person does not repay the loan, she experiences the disutility in the amount of x, the value of which is the private information of a student.

The return requirement ($\mathbf{r}$). The government also decides whether to oblige recipients to return to the home country ($\mathbf{r} = 1$) or not to oblige them to return ($\mathbf{r} = 0$). If a student accepts aid with the return requirement, the student has to return after completion of studies abroad and cannot extricate him/herself from the obligation.[11]

The amount of aid ($\mathbf{a}$). The government also determines the amount of aid ($\mathbf{a} \in [0, c]$). The amount of aid cannot be larger than the cost of the education, because the government may find it difficult to politically justify extremely high expenditure on higher education abroad to taxpayers.

The fraction of applicants receiving aid (α). The government also determines the fraction $\alpha \in [0, 1]$ of applicants who will receive aid. The applicants are the students who, given the government policy, decide to apply for aid at the beginning of the first period. In general, the mass of applicants can be different from the total mass of students. The rule of the aid provision is that the amount $\mathbf{a}$ is randomly distributed to α share of students who applied for the aid.

The lump-sum transfers ($\mathbf{G}$). The government determines the amount of lump sum transfers ($\mathbf{G} \in [0, B]$). The transfers are equally distributed among students at the end of the

[10] Our assumption regarding the exogenous budget level is quite realistic. According to the data, the budget of financial aid programs is usually a tiny fraction of the total budget on higher education (refer to tables 6 and 7 in Appendix D). Therefore, this can indicate that these financial aid programs in reality are an insignificant burden on tax-payers.

[11] It is important to note that the evidence on the avoidance of the return obligation is mixed. Turkey experienced a significantly large number of recipients who did not return after studies although they were obliged to (Gungor and Tansel 2008), whereas in the Philippines the non-return rate was negligible (DAAD and British Council 2014). Our interpretation of this assumption is that the government in principle might be able to place legal restrictions on students intending to stay abroad after their studies (e.g. suspending visa in the host country) and effectively force them to return.

second period after loan repayment. We assume that if the government is indifferent as to providing financial aid and distributing transfers, the government always chooses the latter option over the former. The availability of transfers incorporates an opportunity cost of providing financial aid for the government. Instead of administering educational aid programs, the government can always spend resources on public goods provision and make the whole society better off.[12]

Timing of the Model with Government Intervention. The timing of the model with government intervention is as follows. At the beginning of the first period, the government decides on the policy $(\mathbf{P}, \mathbf{r}, \mathbf{a}, \alpha, \mathbf{G})$. Given the government policy, students decide whether to apply for financial aid. The government distributes aid randomly to α fraction of students who applied for the aid. After the aid is distributed, all persons who received the aid study abroad; all other students remain in the home country. In the second period, when studies are over, the students learn about their failure. Those who failed during their studies and those who receive the aid obliging return in the first period return to their home country; the graduates who obtained the aid without the return requirement and successfully graduated from studies decide between returning home and remaining abroad. Once all decisions on return migration are settled, the productivity of students is publicly revealed and employment occurs at the place of a person's residence. If the students received loans in the first period, they decide on the loan repayment after employment is settled. Once loan repayment decisions are made, the government distributes the lump-sum transfers $\mathbf{G}$ to everyone.

The full timing of the model is illustrated in Figure 2.

Decision on Default. Scholarship recipients are never required to repay the amount of the aid. Loan recipients with no disutility from default ($x = 0$) will never repay loans. Loan recipients with a positive disutility from default ($x = \overline{x}$) will default if they do not earn sufficiently high income after both their failure and their ability are revealed. This occurs when $\theta < c - I$ for $\mu = 1$ and $\theta < \tilde{\theta}^j$ for $\mu = \overline{\mu}$ where

$$\tilde{\theta}^j = \begin{cases} \frac{c-I}{\beta\overline{\mu}} & \text{if} \quad \text{j=R} \\ \frac{c-I}{(1-m)\overline{\mu}} & \text{if} \quad \text{j=F.} \end{cases} \tag{16}$$

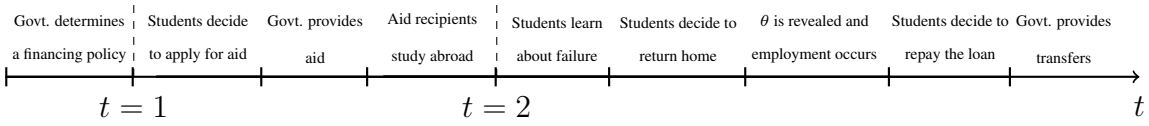
In other words, if a student successfully graduates from studies, the threshold ability level for default depends on the population group.

Students with $x = \overline{x}$ anticipate the probability of loan default that is

$$\nu^j = (1-\pi)Prob(\theta < \tilde{\theta}^j) + \pi Prob(\theta < c - I) \tag{17}$$

where ν^j stands for the probability of loan default for $x = \overline{x}$ students who end up in the population group $j \in \{\{R\}\{F\}\}$. Clearly, the higher the degree of uncertainty, the higher the likelihood of loan default, that is $\frac{\partial \nu^j}{\partial \phi} \geq 0$. In addition, for a substantially low degree of uncertainty, the default probability for $x = \overline{x}$ students becomes 0 and the model is similar to the perfect information case when θ takes on only one value.

Figure 2: Timing of the Model with Government Intervention.



The Government Maximization Problem. The government maximizes the aggregate social welfare subject to the budget constraint:

$$\begin{gathered}\underset{\{P,r,a,\alpha,G\}}{\text{Max}}\, SW\big(P,r,a,\alpha,G\big) = \\ W^H + \alpha\mathbb{E}_x\mathbb{1}^A(P,r,a|x)\big[W^j(P,r,a|x) - W^H + (1-\mathbb{1}^{\overline{x}}(P|x))a + \mathbb{1}^{\overline{x}}(P|x)\nu^j(a-\overline{x})\big] + G \\ s.t. \\ \alpha\mathbb{E}_x\mathbb{1}^A(P,r,a|x)(1-\mathbb{1}^{\overline{x}}(P|x)(1-\nu^j))a + G \leq B; \\ 0 \leq a \leq c; \quad 0 \leq \alpha \leq 1; \quad G \geq 0\end{gathered} \tag{18}$$

where $SW(.)$ stands for the expected aggregate social welfare; W^H is the expected welfare of students from staying in the home country and is determined by equation (9); $\mathbb{1}^{\overline{x}}(P|x)$ is an indicator function that is equal to 1 if $P = P_l$ and $x = \overline{x}$ and to 0 otherwise; ν^j is the probability of the loan default and is determined by equation (17); $\mathbb{1}^A(P,r,a|x)$ is an indicator function which equals to 1 if students apply for the aid and to 0 otherwise. Alternatively,

$$\mathbb{1}^A(P,r,a|x) = \begin{cases} 1 & \text{if } \; r=1 \;\; \& \;\; \mathbb{U}^R(P,a|x) \geq U^H \\ & \text{or } \; r=0 \;\; \& \;\; max(\mathbb{U}^R(P,a|x), \mathbb{U}^F(P,a|x)) \geq U^H \\ 0 & \text{otherwise} \end{cases} \tag{19}$$

where $\mathbb{U}^j(P,a|x) = U^j + (1-\mathbb{1}^{\overline{x}}(P|x)(1-\nu^j))a - \mathbb{1}^{\overline{x}}(P|x)\nu^j\overline{x}$ for $j \in \{\{R\}\{F\}\}$ and the functional form of U^j is determined by equations (3) and (4). That is, students apply for aid if the new population group generates the expected utility gain net of the loss from the possible loan default, if applicable; $W^j(P,r,a|x)$ is the expected welfare of students who received the financial aid and end up in the population group $j \in \{\{R\}\{F\}\}$, that is

$$W^j(P,r,a|x) = \begin{cases} W^R & \text{if } \; r=1 \;\; \text{or } \; r=0 \;\; \& \;\; \mathbb{U}^R(P,a|x) \geq \mathbb{U}^F(P,a|x) \\ W^F & \text{otherwise} \end{cases} \tag{20}$$

where W^R and W^F are determined by equations (10) and (11).

The maximization problem implies that scholarships are a type of aid with no obligation to repay and therefore all students will keep the amount in the second period. In the case of loans, students with $x = 0$ will keep the loan amount in the second period without any loss. Students with $x = \overline{x}$ will not repay the loan with probability ν^j. The default

[12]This assumption is also necessary to avoid multiplicity of solutions.

creates the disutility equal to $a - \overline{x} < 0$. Therefore, the default risk creates expected social welfare losses for students with $x = \overline{x}$ and can potentially distort their decision to accept loans.

With regard to the budget, the government expenditure is equal to the total amount of aid that is not repaid. If the aid is repaid, there is no cost for the government. Since scholarships do not oblige repayment, their expenditure will be exactly equal to the amount of distributed scholarships; that is, to αa. In the case of loans, the total expenditure on loans is the expected amount of default; that is, $\alpha(\gamma_x + (1 - \gamma_x)\nu^j)a$, i.e. lower compared to scholarships. This implies that if the government budget is tight, loans induce lower expenses and allow the government to finance a larger fraction of students compared to scholarships.[13]

The discussion above is summarized in two observations below.

Observation 1 (default effect). For a sufficiently high degree of uncertainty (ϕ), loans create an expected loss in welfare that is absent for the scholarship.

Observation 2 (budgetary effect). For a fixed requirement on return, a fixed amount of the aid, and a fixed share of aid applicants, loans can finance a larger or equal fraction of students compared to scholarships.

These two observations imply that the optimal government policy depends on which default and budgetary effect is stronger and on the tightness of the budget.[14]

4.3.1 The Optimal Government Policy

The optimal government policy depends on the parameter levels ($\mathbb{E}(\theta)$, m). Below, we analyze the optimal government policy for four distinct cases (see Figure 3.). Each case stands for a specific range of $(\mathbb{E}(\theta), m)$.

Case I. $\mathbb{E}(\theta) < min(\hat{e}_1^S, \hat{e}_2)$**.**

Case I describes the conditions in which it is neither socially nor privately optimal to study abroad because students' expected ability is low. Clearly, in this case, the government will remain inactive and the students will remain at home.

Proposition 4.1. *Given case I, the government does not provide any financial aid ($P_i^* = P_0$).*

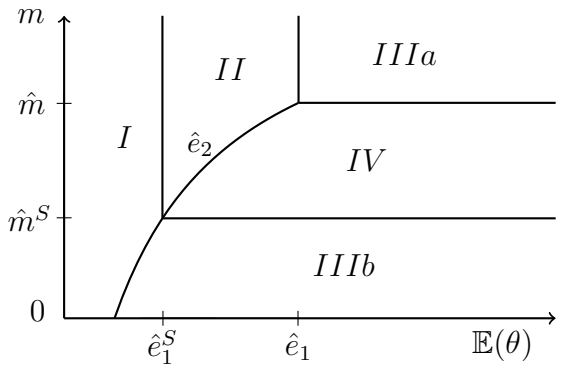
Next, we consider the cases for which the government strictly benefits from the intervention. The proofs of the propositions are presented in Appendix E. Below we develop an economic intuition behind each result.

Case II. $\mathbb{E}(\theta) \in [\hat{e}_1^S, min(\hat{e}_1, \hat{e}_2))$.

[13] One can imagine that the government can always borrow the money even though the budget level B is fixed.

[14] Clearly, if the budget is sufficiently large and the government is able to finance all students, there will be no budgetary effect of loans over scholarships.

Figure 3: The Socially and Privately (under no financial constraints) Optimal Outcomes and the Optimal Government Policy (P^*, r^*) for Different Values of $(\mathbb{E}(\theta), m)$ when $\chi \in (1, \frac{1}{\beta})$



Case I. Privately optimal: H, Socially optimal: H, Optimal Govt. Policy: (P_0, r)
Case II. Privately optimal: H, Socially optimal: R, Optimal Govt. Policy: $(P_s, 1)$
Case $IIIa$. Privately optimal: R, Socially optimal: R, Optimal Govt. Policy: $(P_l, 0)/(P_s, 0)$
Case $IIIb$. Privately optimal: F, Socially optimal: F, Optimal Govt. Policy: $(P_l, 0)/(P_s, 0)$
Case IV. Privately optimal: F, Socially optimal: R, Optimal Govt. Policy: $(P_l, 0)/(P_l, 1)/(P_s, 1)$

Proposition 4.2. *Given case II, the (weakly) optimal government policy is a scholarship with the return requirement ($P^*_{ii} = P_s$, $r^*_{ii} = 1$).*

For case II, it is socially optimal for students to study abroad and return ($W^R > W^H > W^F$). From the private point of view, these students would never study abroad even in the absence of financial constraints ($U^H > max(U^R, U^F)$).

Since group F is always inferior from both the social and private points of view, it immediately follows that requiring students to return is a (weakly) dominant policy for the government $r^*_{ii} = 1$. Since under no financial constraints students would remain at home, they need to receive a sufficient amount of aid to study abroad. A scholarship is non-repayable aid and all students will apply if a sufficient amount is provided. A loan is repayable aid and does not create any gain for students with $x = \overline{x}$. Consequently, these students will never apply for loans of any amount. Therefore, it follows that scholarships will induce a larger fraction of applications and generate higher social welfare compared to loans.

Case $IIIa - b$. $[\mathbb{E}(\theta) \geq \hat{e}_2, m < \hat{m}^S] \cup [\mathbb{E}(\theta) > \hat{e}_1, m \geq \hat{m}]$.

Proposition 4.3. *Given cases $IIIa - b$, there is a threshold level for the government budget ($\tilde{B}^{a-b}_{iii}(\phi)$), such that if $B \leq \tilde{B}^{a-b}_{iii}(\phi)$, the (weakly) optimal government policy is a loan without the return requirement ($P^*_{iii} = P_l$, $r^*_{iii} = 0$). If $B > \tilde{B}^{a-b}_{iii}(\phi)$, the (weakly) optimal government policy is a scholarship without the return requirement ($P^*_{iii} = P_s$, $r^*_{iii} = 0$). In addition, the threshold level $\tilde{B}^{a-b}_{iii}(\phi)$ is non-increasing in the degree of uncertainty ($\frac{\partial \tilde{B}^{a-b}_{iii}(\phi)}{\partial \phi} \leq 0$)*

For case $IIIa-b$ the socially and privately (under no financial constraints) optimal population groups coincide and are R for case $IIIa$ and F for case $IIIb$. Therefore, the government does not need to distort the return decision of students and the optimal policy is not to require them to return: $r^*_{iii}=0$.

Given $r^*_{iii}=0$, we analyze different degrees of uncertainty ϕ. First, suppose that the degree of uncertainty is sufficiently low that no one defaults on loans ($\nu^j=0$). Since $max(U^R,U^F)-U^H>0$, it follows that *all* students will apply for a loan if it enables them to cover the education cost. Hence, there will be no default and loans will have only the budgetary effect. Therefore, the government will (weakly) prefer loans to scholarships.[15]

Second, suppose the uncertainty is sufficiently high, such that the default probability is so large that $x=\overline{x}$ students never apply for loans ($(max(U^R,U^F)-U^H+\nu^j(c-\overline{x})<0$). Then, there will be no budgetary effect since only student with $x=0$ will apply for a sufficiently high amount of loan. Similar to the logic of case II, a scholarship without the return requirement will be a dominant policy.

Finally, for the intermediate value of the uncertainty, the budgetary effect of loans dominates the default effect when the government budget is tight. As the government has more resources available, the budgetary effect becomes weaker and the government switches to scholarships. Importantly, increasing the degree of uncertainty leads to magnifying of the default effect and to the weakening of the budgetary effect. Therefore, as students become more uncertain about their own ability, the government becomes more inclined to offer scholarships.

Case IV. $\mathbb{E}(\theta)\geq\hat{e}_1$, $m\in[\hat{m}^S,\hat{m})$.

Proposition 4.4. *Given case IV, there are up to three segments of B divided by thresholds $\tilde{B}^I_{iv}(\phi)$ and $\tilde{B}^{II}_{iv}(\phi)$ where $\tilde{B}^I_{iv}(\phi)\geq\tilde{B}^{II}_{iv}(\phi)\geq 0$, such that*

-If $B<\tilde{B}^{II}_{iv}(\phi)$, the optimal government policy is a loan without the return requirement ($P^*_{iv}=P_l$, $r^*_{iv}=0$).

-If $\tilde{B}^{II}_{iv}(\phi)\leq B<\tilde{B}^I_{iv}(\phi)$, the optimal government policy is a loan with the return requirement ($P^*_{iv}=P_l$, $r^*_{iv}=1$).

-If $B\geq\tilde{B}^I_{iv}(\phi)$, the optimal government policy is a scholarship with the return requirement ($P^*_{iv}=P_s$, $r^*_{iv}=1$).

In addition, the highest threshold value of the government budget is non-increasing in the degree of uncertainty ($\frac{\partial\tilde{B}^I_{iv}(\phi)}{\partial\phi}\leq 0$).

For case IV, studying abroad and returning to the home country is a socially desirable outcome ($W^R>W^F>W^H$), whereas under no financial constraints students would study and remain abroad ($U^F>U^R>U^H$).

First, similar to the logic of case III, the government will choose either loans with the return requirement or scholarships with the return requirement depending on the degree of

[15] For a large value of B the government will be indifferent as to loans and scholarships.

uncertainty and on whether the budgetary effect is higher or lower than the default effect of loans.

However, the government might prefer to provide loans without the return requirement, although this policy leads to a socially sub-optimal population group F ($W^R > W^F$ for case IV), because loans without the return requirement generate a lower default probability ($m < 1-\beta \implies \nu^R \geq \nu^F$). Lower probability of default also implies lower budgetary expenses and a stronger budgetary effect, since more students can be financed. Therefore, if the budgetary effect is larger than the default effect together with the loss in social welfare ($W^R - W^F$), the government will choose loans without the return requirement over loans with the return requirement.

A summary of the results is in Figure 3. The next section extends the model and finds the range of parameters for which the stylized facts can be generated.

4.4 Extension and the Stylized Facts

This section builds on the previous section to demonstrate that the extended version of the model with two ex-ante ability types of students and two types of schools can qualitatively replicate all stylized facts.

The extended model is as follows. There are two groups of students: γ^h fraction of ex-ante high-ability students and γ^l fraction of ex-ante low-ability students ($\gamma^h + \gamma^l = 1$). Neither of these students nor the government knows individual productivity. The productivity is drawn from a uniform distribution in the second period. The distribution of students' ability is public information and fully described by $(\mathbb{E}(\theta^h), \phi)$ for ex-ante high-ability students and by $(\mathbb{E}(\theta^l), \phi)$ for low-ability students such that $\mathbb{E}(\theta^h) > \mathbb{E}(\theta^l)$. Both types of students face the same degree of uncertainty ϕ. Alternatively, even if the students' productivity cannot be perfectly evaluated, some students are perceived as more able compared to their peers (for instance, some students have better grades at school than others).

In addition, there are two schools available in the foreign country. One school provides a graduate degree and another offers an undergraduate degree. The return to graduate and undergraduate education (in the case of no failure) are $\overline{\mu}^g$ and $\overline{\mu}^u$, respectively, such that $\beta\overline{\mu}^g > \beta\overline{\mu}^u > 1$.

If a students studies abroad, she is allowed to choose to study only in one type of school. If a student studies at the graduate school, she faces a positive probability of failure π^i where $i \in \{\{h\}\{l\}\}$. It is assumed that ex-ante high-ability students face a lower probability of failure; that is, $\pi^h < \pi^l$. Further, we assume that the values of π^h and π^l are such that high-ability students always choose to study at graduate school to undergraduate school and low-ability students choose the opposite:

$$\pi^l > max\Big(\frac{\beta(\overline{\mu}^g - \overline{\mu}^u)}{\beta\overline{\mu}^g - 1}, \frac{(1-m)(\overline{\mu}^g - \overline{\mu}^u)}{(1-m)\overline{\mu}^g - 1}\Big) \tag{21}$$

and

$$\pi^h < min\Big(\frac{\beta(\overline{\mu}^g - \overline{\mu}^u)}{\beta\overline{\mu}^g - 1}, \frac{(1-m)(\overline{\mu}^g - \overline{\mu}^u)}{(1-m)\overline{\mu}^g - 1}\Big). \tag{22}$$

Finally, since graduate studies are generally more difficult compared to undergraduate studies, we assume that no failure is involved during studies at the undergraduate school. Throughout the rest of the section we denote π^h by π.

Within the modified environment, the government determines a financial aid policy that is conditional on each ability group of students $((P^i, r^i, \alpha^i, a^i, G)$ where $i \in \{\{h\}\{l\}\})$. The maximization problem is:

$$\begin{gathered} Max_{\{P^i, r^i, a^i, \alpha^i, G\}} SW(P^i, r^i, a^i, \alpha^i, G) = \\ \sum_{i \in \{\{h\}\{l\}\}} \gamma^i \Big[W^{i,H} + \alpha^i \mathbb{E}_x \mathbb{1}^{i,A}(P^i, r^i, a^i|x) \big[W^{i,j}(P^i, r^i, a^i|x) - W^{i,H} + \\ (1 - \mathbb{1}^{i,\overline{x}}(P^i|x)) a^i + \mathbb{1}^{i,\overline{x}}(P^i|x) \nu^{i,j}(a^i - \overline{x}) \big] + G \\ \text{s.t.} \\ \sum_{i \in \{\{h\}\{l\}\}} \gamma^i \alpha^i \mathbb{E}_x \mathbb{1}^{i,A}(P^i, r^i, a^i|x)(1 - \mathbb{1}^{\overline{x}}(P^i|x)(1 - \nu^{i,j}) a^i + G \leq B \\ 0 \leq a^i \leq c; 0 \leq \alpha^i \leq 1; G \geq 0. \end{gathered} \tag{23}$$

All variables are defined similarly to the benchmark model.

Below we identify the range of parameters that can generate the stylized facts.
Proposition 4.5. *Suppose that the following conditions hold :*

$$\mathbb{E}(\theta^h) > \frac{c}{(1-\pi)((1-m)\overline{\mu}^g - 1)}, \tag{24}$$

$$\mathbb{E}(\theta^l) > \frac{c}{((1-m)\overline{\mu}^u - 1)}, \tag{25}$$

$$\gamma^h > \frac{(\chi\beta\overline{\mu}^u - 1)\mathbb{E}(\theta^l) - c}{(1-\pi)(\chi\beta\overline{\mu}^g - 1)\mathbb{E}(\theta^h) + (\chi\beta\overline{\mu}^u - 1)\mathbb{E}(\theta^l) - 2c}, \tag{26}$$

and

$$k > \frac{(\chi\beta\overline{\mu}^u - 1)\mathbb{E}(\theta^l) - c}{(1-\pi)(\chi\beta\overline{\mu}^g - 1)\mathbb{E}(\theta^h) + (\chi\beta\overline{\mu}^u - 1)\mathbb{E}(\theta^l) - 2c} \tag{27}$$

where k solves the following equation:

$$\begin{gathered} (1-\pi) max\Big(\frac{(\frac{c-E}{(1-m)\overline{\mu}^g}(k+2) - 2\mathbb{E}(\theta^h)}{2\mathbb{E}(\theta^h)k}, 0\Big) + \pi\frac{(c-E)(k+2) - 2\mathbb{E}(\theta^h)}{2\mathbb{E}(\theta^h)k} = \\ \frac{(1-\pi)(\chi\beta\overline{\mu}^g - 1)\mathbb{E}(\theta^h) - c}{(1-\pi)(\chi\beta\overline{\mu}^g - 1)\mathbb{E}(\theta^h) - c + \overline{x}}. \end{gathered} \tag{28}$$

There are ranges of the degree of uncertainty ($\phi \in [\tilde{\phi}^I, \tilde{\phi}^{II}]$), the living cost abroad ($m \in [\hat{m}^S, \tilde{m}^I]$), and the government budget $B \in [\tilde{B}^I, \tilde{B}^{II}]$, such that the government prioritizes the high-ability students over low-ability students. Furthermore, given these ranges, the government finances all high-ability students with scholarships with the return requirement, and distributes the remainder of the budget in the form of loans without the return requirement to the low-ability students ($P^{h,*} = P_s$, $r^{h,*} = 1$, $P^{l,*} = P_l$, $r^{l,*} = 0$).

Equations (24) and (25) guarantee that it is ex-ante socially optimal for both type of students to study abroad. Equation (26) stands for the condition that the government always prefers to finance high-ability students rather than low-ability students and clearly this happens for sufficiently high γ^h. Equations (27) and (28) guarantee the existence of the segments for the living cost abroad, degree of uncertainty, and the budget level mentioned in the proposition.

The story of proposition 4.5 is the following. Students (both types) are ex-ante high able such that they prefer to study and permanently remain abroad. Due to externality, the government wishes to send students abroad and to induce them to return upon graduation. In addition, the share of ex-ante high-ability students is sufficiently high and the government with a tight budget prioritizes financing them over financing the low-ability students. Since graduate studies involve the risk of failure, when the default effect of a loan dominates its budgetary effect, it is optimal to support high-ability students with scholarships with the return requirement. Since undergraduate studies have no risk of failure, the budgetary effect of a loan can be higher than the default effect and the government might opt for loans. For certain ranges of parameters, the government by offering loans without the return requirement to low-ability students will mitigate the default effect and increase the budgetary effect.

5 Discussion and Further Research

We identify and theoretically analyze existing government-funded financing programs targeted towards higher education abroad. The unique data-set collected via Internet search allows us to compare programmatic characteristics of scholarship and loan programs in middle and low income countries. The stylized facts arising from the data demonstrate that scholarship programs are more likely to support students with higher academic merit, be aimed at graduate/postgraduate studies, and require recipients to return than loan programs.

We interpret stylized facts from a developing country perspective. We provide a two-country student migration model with financial constraints and a positive externality from "returnee" students. Neither students nor the government knows individual ability, which becomes observable only during employment. Additionally, there is a fraction of people who experience high disutility from loan default. Within this environment, the model shows that since some part of loans is always repaid, loan programs are cheaper and allow the government with a tight budget to send a higher fraction of students abroad compared

Table 2: Stylized Facts for Middle and Low Income Countries and Performance of the Theoretical Model.

Fact 1	Scholarship programs more frequently select students based on merit criteria than loan programs do.	Proposition 4.5
Fact 2	Scholarship programs are more likely to promote graduate and postgraduate studies than loan programs.	Proposition 4.5
Fact 3	Scholarship programs are more likely to require recipients to return after completion of studies than loan programs.	Proposition 4.5

to scholarships. However, if there is a sufficiently high likelihood of students entering the employment market with low-productivity, loans might create higher expected losses due to possible default. Hence, if the budgetary effect of the loan is offset by possible losses from default, the optimal government policy will be to provide scholarships to insure students against non-repayment. We show that when students are heterogeneous in their expected ability and certain conditions hold, the government prioritizes the high-ability students and finances their graduate education with scholarships with the return requirement, and finances the undergraduate education of low-ability students with loans without the return requirement.

A summary of the stylized facts and the performance of the model is presented in Table 2. The current model succeeded in qualitatively explaining all three stylized facts on the comparison of financing policies promoting education abroad in middle and low income countries.

There are several fruitful directions in which to extend the analysis presented in this paper. One is to calibrate the model and confirm that it works well quantitatively, and to confirm that the identified range of parameters is consistent with the data. Another direction would be to analyze the optimal government policy in more general settings. In our model developed countries were inactive. However, a realistic environment would be a scenario in which developed countries lay out tuition fees and immigration policies for international students from developing countries and the developing countries provide financial support to their students for education abroad.

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Appendix A Key Terms and Definitions

This sections defines the terms used throughout the paper.

Developing country. Developing country is defined as a middle or low income country. **Country income group classification.** The country group classification (high, middle and low income countries) is based on the World Bank classification of countries by Gross National Income per capita.

We classify financial aid programs promoting higher education abroad into two categories: scholarship programs and loan programs.

Scholarship program. We use the term scholarship to designate *non-repayable* education aid provided by a government to students to (fully or partially) cover either tuition fees or living/travel expenses during studies abroad, or both.

Loan program. We use the term loan to designate *repayable* education aid provided by a government to students to cover (fully or partially) either tuition fees or living/travel expenses, or both. The loan programs require students to (fully or partially) repay the amount of the aid (potentially with accrued interest) after completion of their studies abroad.

Return obligation. We define a program to have the return obligation if it is directly stated that a student is required or expected to return to the home country after their studies.

If a scholarship or loan program states that students are not required to return or provides no information regarding the return obligation, we interpret this as the government not requiring recipients to return after studies.

Note that the definitions of the program types do not allow us to distinguish scholarships that have to be repaid if a recipient does not return to the home country (**grants with operating return**). In our setting, we interpret these policies as being scholarships. Nevertheless, such interpretation does not qualitatively alter our stylized facts.

Selection based on merit criteria. We identify whether a program selects recipients based on certain merit. We define a program to be selective based on merit if at least one of the conditions below hold:

a) The program directly states that aid is given based on merit criteria.

b) The program requires recipients to demonstrate a minimum level of academic competency (such as minimum GPA) and/or the knowledge of a host country language (language test scores).

c) The program requires recipients to send documents related to academic achievements and/or work experience (academic records, standardized test scores, CV, etc.)

d) The program requires recipients to be accepted to a top school abroad.

If a program does not provide any information regarding selection based on merit, it is interpreted as missing or not having selection based on merit criteria.

Study level. We focus on two main study levels: undergraduate and graduate/postgraduate. Undergraduate level is equivalent to Bachelor's degree and graduate/postgraduate level include Master's and Ph.D. degrees. According to the data, some policies are exclusively targeted towards a specific study level (New Colombo Plan promoting undergraduate studies in Australia; postgraduate scholarship program Beca 18 in Peru), while others promote both levels (Bafog student loan in Germany; King's Scholarship in Thailand).

If a program mentions only one level of study, e.g. postgraduate level, we interpret this as the program exclusively targeting the postgraduate level.

If a program either mentions both levels of study or does not provide any information regarding the study level, we interpret this as the program not differentiating between levels.

Two reasons can explain why information about a characteristic, e.g. academic merit, is not specified on the website. First, the program does not select based on academic criteria and does not mention it on the website (this is our interpretation). Second, the program has the requirement but the information is simply missing. If the missing values are systematically present for scholarship or loan programs, the qualitative strengths of the stylized facts might be undermined. In any case, it seems reasonable to assume that a program not requiring recipients to return after studies does not mention the return obligation at all.

Appendix B Methodology for Searching Programs

Scholarship Programs

1) Identify the official language(s) of the country.
2) Search for the English version web-site of the ministry of education and search "scholarship" or "grant" in the search tool.
3) Search via Google, first in English and then in the official language(s), combinations of the following words:
"country name government scholarship study overseas .countrycode"
"country name government scholarship study abroad .countrycode"
"country name government scholarship foreign education .countrycode"
"country name government financial aid study overseas .countrycode"
"country name government financial aid study abroad .countrycode"
"country name government financial aid foreign education .countrycode"
"country name government grant study overseas .countrycode"
"country name government grant study abroad .countrycode"
"country name government grant foreign education .countrycode"
4) Check on several sources, case studies, and projects, such as The International Comparative Higher Education Finance and Accessibility Project (2009), Mapping European

Union Member States Higher Education External Cooperation Programmes and Policies (2010), UNESCO (2010), UNESCO (2012), the World Bank (2010).
5) If not found in either of these sources -> identify as not found.

Loan Programs

1) Identify the official language(s) of a country.
2) Search for the English version web-site of the ministry of education and search "loan" in the search tool.
3) Search via Google, first in English and then in the official language(s), combinations of the following words:
"country name government loan study overseas .countrycode"
"country name government loan study abroad .countrycode"
"country name government loan foreign education .countrycode"
"country name student loan study abroad .countrycode"
"country name student loan study overseas .countrycode"
"country name student loan foreign education .countrycode"
"country name student credit study abroad .countrycode"
"country name bank student loan study abroad .countrycode"
4) Check on several sources, case studies, and projects, such as The International Comparative Higher Education Finance and Accessibility Project (2009), Mapping European Union Member States Higher Education External Cooperation Programmes and Policies (2010), UNESCO (2010), UNESCO (2012), the World Bank (2010).
5) If not found in either of these sources -> identify as not found.

Appendix C Description of the Programs

This section contains the methodology and the description of various characteristics of government-funded scholarship and loan programs promoting education abroad. The data is collected by the author using a web search engine during the period January-May, 2015. The last update was performed in August, 2015. The full data-set is available upon request.

Variables for Scholarship Programs:

I. Country.
II. Income group of a country (World Bank source).
III. Scholarship name.
IV. Web-source of the scholarship.
V. Starting date.
VI. Last year of being active.
VII. Budget of the scholarship.
VIII. Existence of private/other funding share in the budget of the scholarship (yes/no).
IX. Number of students financed.

X. Merit-based.
XI. Means-tested.
XII. Existence of a ceiling on the scholarship amount (yes/no).
XIII. Coverage of the scholarship (Tuition fees and living cost – 1, only tuition fee – 2, only living cost – 3).
XIV. The degree intensity (degree attainment – 1, short term/exchange – 2, both – 3).
XV. Study level (undergraduate only – 1, graduate/postgraduate only – 2, both – 3).
XVI. Fields – (priority fields - 1, any field with exceptions - 2, any field – 3).
XVII. Destination (exclusively one(or several) school(s) - 1, restricted to top schools in the field - 2, restricted to specific region - 3, restricted other- 4, No restriction - 5).
XVIII. Information about the amount of the scholarship.
XIX. Information about fields financed.
XX. Information about location and occupation.
XXI. Return obligation after completion of studies (yes/no).
XXII. The (minimum) number of years that is required for a recipient to work in the home country after completion of studies.
XXIII. Working requirement in a specific sector after completion of studies (yes/no).
XIV. The amount of the penalty that a recipient should pay in case of non-return (% of the scholarship amount paid to the recipient).
XXV. Return Benefits (yes/no).
XXVI. Comments on return requirement.

Variables for Loan Programs:

I. Country.
II. Income group of a country (World Bank source).
III. Loan name.
IV. Web-source of the loan.
V. Starting date.
VI. Last year of being active.
VII Type of the loan (pure loan – 1, hybrid loan – 2).
VIII Information about the type of loan.
IX. The Budget.
X. Number of students financed.
XI. Merit-based.
XII. Means-tested.
XIII. The degree intensity (degree attainment – 1, short term/exchange – 2, both – 3).
XIV. Study level (undergraduate only – 1, graduate/postgraduate only – 2, both – 3).
XV. Fields – (priority fields - 1, any field with exceptions - 2, any field – 3).
XVI. Destination (exclusively one (or several) school(s) - 1, restricted to top schools in the field - 2, restricted to specific region - 3, restricted other- 4, No restriction - 5).
XVII. Information about the amount of the scholarship.
XVIII. Information about fields financed.
XIX. Information about location and occupation.
XX. Return obligation after completion of studies (yes/no).

XXI. The (minimum) number of years that is required for a recipient to work in the home country after completion of studies.
XXII. The requirement to work in a specific sector/occupation after completion of studies (yes/no).
XXIII. The amount of the penalty that a recipient should pay in case of non-return (% of the scholarship amount paid to the recipient).
XXIV. Return Benefits (yes/no).
XXV. Comments on return requirement.
XXVI. Security type (only collateral – 1, only third party guarantee (organization, person) - , both – 3, no security – 4).
XXVII. Interest rate during studies.
XXVIII. Interest rate after completion of studies.
XXIX. Government subsidization of the interest rate (full/partial).
XXX. The maximum number of years for repayment of the loan.
XXXI. Number of months of a grace period.
XXXII. Other comments.

Appendix D Summary Tables and Figures

Table 3: Countries Operating Only Scholarship Programs

Country	Income group
Andorra	High
Austria*	High
Bahrain	High
Belgium	High
Chile	High
Cyprus*	High
Czech Republic	High
Estonia*	High
Greece*	High
Ireland*	High
Latvia	High
Oman	High
Poland*	High
Portugal*	High
Saudi Arabia	High
Singapore	High
Slovenia*	High
Spain	High
Switzerland*	High
United Arab Emirates	High
Albania	Upper-Middle
Angola	Upper-Middle

Country	Income group
Argentina	Upper-Middle
Azerbaijan	Upper-Middle
Brazil*	Upper-Middle
China*	Upper-Middle
Dominican Republic	Upper-Middle
Gabon	Upper-Middle
Iraq	Upper-Middle
Jordan	Upper-Middle
Kazakhstan*	Upper-Middle
Libya	Upper-Middle
Thailand*	Upper-Middle
Turkey	Upper-Middle
Egypt	Lower-Middle
El Salvador	Lower-Middle
Federated States of Moldova	Lower-Middle
Ghana	Lower-Middle
Indonesia*	Lower-Middle
Lesotho	Lower-Middle
Mauritania	Lower-Middle
Pakistan	Lower-Middle
South Sudan	Lower-Middle
Vietnam*	Lower-Middle
Liberia*	Low
Rwanda	Low

*These countries have more than one scholarship program.

Table 4: Countries Operating Only Loan Programs

Country	Income group
Brunei	High
Iceland	High
Liechtenstein	High
New Zealand	High
Botswana	Upper-Middle
Colombia*	Upper-Middle
Malaysia	Upper-Middle
Maldives	Upper-Middle
Mauritius*	Upper-Middle
Tunisia	Upper-Middle
Cabo Verde	Lower-Middle
Guatemala	Lower-Middle
Tanzania	Low
Uganda	Low
Zimbabwe	Low

*These countries have more than one loan program.

Table 5: Countries Operating Both Scholarship and Loan Programs

Country	Income group
Antigua and Barbuda	High
Australia*	High
Barbados	High
Canada	High
Denmark*	High
Finland*	High
France*	High
Germany*	High
Italy*	High
Japan	High
Korea, South	High
Kuwait	High
Lithuania	High
Luxembourg*	High
Malta*	High
Netherlands*	High

Country	Income group
Norway*	High
Russia*	High
Slovakia	High
Sweden*	High
Trinidad and Tobago	High
United Kingdom*	High
United States*	High
Ecuador*	Upper-Middle
Marshall Islands	Upper-Middle
Mexico	Upper-Middle
Namibia	Upper-Middle
Panama	Upper-Middle
Peru	Upper-Middle
Seychelles	Upper-Middle
Georgia	Lower-Middle
India*	Lower-Middle
Mongolia	Lower-Middle
Mozambique	Low

*These countries have more than one loan and one scholarship program.

Table 6: The Expenditure of Scholarship Programs

Country	Income group	The Avg % of the Expenditure on Scholarship programs in the Total Budget of Tertiary Education*
Albania	Upper-Middle	0.29
Azerbaijan	Upper-Middle	1.55
Brazil	Upper-Middle	2.19
Kazakhstan	Upper-Middle	0.04
Egypt	Lowe-Middle	0.12
El Salvador	Lower-Middle	1.92
Georgia	Lower-Middle	0.00
India	Lower-Middle	0.00
Yemen	Lower-Middle	3.51

Table 7: The Expenditure of Loan Programs

Country	Income Group	The Avg % of the Expenditure on Loan Programs in the Total Budget of Tertiary Education*
Botswana	Upper-Middle	9.84
Colombia	Upper-Middle	0.04
Georgia	Lower-Middle	0.44

*The indicator for the budget shows the total amount of the scholarship/loan paid to the students.

Table 8: The Number of Students sent abroad by Scholarship Programs in Middle and Low Income Countries

Country	Income Group	The Avg Num of Students per Million Population Sent By Scholarship Programs per Year
Albania	Upper-Middle	33.71
Angola	Upper-Middle	8.42
Azerbaijan	Upper-Middle	86.85
Ecuador	Upper-Middle	85.45
Gabon	Upper-Middle	1637.09
Kazakhstan	Upper-Middle	71.65
Libya	Upper-Middle	1128.76
Mexico	Upper-Middle	30.06
Peru	Upper-Middle	16.46
Turkey	Upper-Middle	15.86
Egypt	Lower-Middle	2.96
El Salvador	Lower-Middle	11.63
Georgia	Lower-Middle	25.63
India	Lower-Middle	0.03
Indonesia	Lower-Middle	6.99
Mongolia	Lower-Middle	82.78
Pakistan	Lower-Middle	2.75
South Sudan	Lower-Middle	252.24
Vietnam	Lower-Middle	15.61
Liberia	Low	10.74
Rwanda	Low	11.22

Table 9: The Number of Students sent abroad by Loan Programs in Middle and Low Income Countries

Country	Income Group	The Avg Num of Students per Million Population Sent By Loan Programs per Year
Botswana	Upper-Middle	3776.52
Colombia	Upper-Middle	21.53
Maldives	Upper-Middle	34.78
Namibia	Upper-Middle	2001.58
Tunisia	Lower-Middle	10.45
Georgia	Lower-Middle	2.49
India	Lower-Middle	0.22
Zimbabwe	Low	0.61

Table 10: Summary Table on the Comparison of Financial Aid Policies in Middle and Low Income Countries

Middle/Low Income	Total #	%	Return Obligation		Academic Merit		Study Level		
			Yes	No/Not Specified	Yes	No/Not Specified	Under-graduate	Graduate/ Postgraduate	Both/Not Specified
Total Policies	76	100%	39.47%	60.53%	59.21%	40.79%	1.32%	44.73%	53.95%
Scholarships	51	67.11%	54.90%	45.10%	64.71%	35.29%	1.96%	56.86%	41.18%
Loans	25	32.89%	8.00%	92.00%	48.00%	52.00%	0.00%	20.00%	80.00%

Appendix E Proofs

The market and social Outcomes. Based on equations (2), (3), and (4), under no financial constraints a student would choose group $D \in \{H, R, F\}$, if $max(U^H, U^R, U^F) = U^D$. This gives conditions described in equations (6), (7), and (8). Similarly, based on equations (9), (10), and (11), and the maximization problem (12), the socially optimal outcome is population group D if this group generates the maximum social welfare, or $max(W^H, W^R, W^F) = W^D$. This gives the conditions described in equations (13), (14), and (15).

The support of the distribution of θ. Since the distribution of θ is uniform and $\mathbb{E}(\theta)$ and ϕ are given, the functional forms of the upper and lower bounds of the support are derived from the following two equations:

$$\begin{aligned} \mathbb{E}(\theta) &= \frac{\underline{\theta} + \overline{\theta}}{2} \\ \phi &= \frac{\overline{\theta}}{\underline{\theta}} - 1. \end{aligned} \tag{E-1}$$

The default probability. Students who failed during studies abroad default on loans if

$$I + \theta - c < 0 \implies \theta < c - I. \tag{E-2}$$

Students who successfully graduated from studies abroad and returned to the home country default on loans if

$$I + \beta\overline{\mu}\theta - c < 0 \implies \theta < \tilde{\theta}_s^R = \frac{c - I}{\beta\mu}. \tag{E-3}$$

Students who successfully graduated from studies abroad and remained in the foreign country default on loans if

$$I + (1 - m)\overline{\mu}\theta - c < 0 \implies \theta < \tilde{\theta}_s^F = \frac{c - I}{(1 - m)\mu}. \tag{E-4}$$

Using the fact that θ is uniformly distributed between $\frac{2\mathbb{E}(\theta)}{\phi+2}$ and $\frac{2\mathbb{E}(\theta)(\phi+1)}{\phi+2}$ one will arrive to equation:

$$\nu^j = max\big((1-\pi)max\Big(\frac{\tilde{\theta}^j(\phi+2)-2\mathbb{E}(\theta)}{2\mathbb{E}(\theta)\phi},0\Big)+\pi\frac{(c-I)(\phi+2)-2\mathbb{E}(\theta)}{2\mathbb{E}(\theta)\phi},0\big). \tag{E-5}$$

From the equation above, it immediately follows that $\frac{\partial\nu^j}{\partial\phi} \geq 0$ and ($\frac{d\nu^j}{d\phi} \geq 0$). It is also straightforward to show that when $\phi \leq \frac{2\mathbb{E}(\theta)}{c-I} - 2 \implies \nu^j = 0$.

Case II.

Below we consider the model with a sufficiently low degree of uncertainty $\phi \leq \frac{2\mathbb{E}(\theta)}{c-I} - 2$ such that $\nu^j = 0$. It suffices to prove that scholarships with the return requirement are the optimal policy for $\phi \leq \frac{2\mathbb{E}(\theta)}{c-I} - 2$.

We first discuss the government tools conditional on each type of financial aid, and from there we derive the optimal government policy type.

First, since $U^H > max(U^F, U^R)$ and $W^R > W^H > W^F$, it immediately follows that the government will always (weakly) prefer to set the return requirement ($r^s_{ii} = r^l_{ii} = 1 = r^*_{ii}$).

The second step is to find the optimal amount of the government policy. Students will apply for loans if:

$$\mathbb{1}^A(P_l, 1, a|x=\overline{x}) = 1 \iff U^R - U^H > 0 \;\&\; a \geq c - I \tag{E-6}$$

and

$$\mathbb{1}^A(P_l, 1, a|x=0) = 1 \iff U^R - U^H + a > 0 \;\&\; a \geq c - I. \tag{E-7}$$

Similarly, students will apply for scholarships if

$$\mathbb{1}^A(P_s, 1, a|x) = 1 \iff U^R - U^H + a > 0 \;\&\; a \geq c - I \;\forall\, x. \tag{E-8}$$

Since $U^R - U^H < 0$, students with $x = \overline{x}$ will never apply for loans. As for the optimal amount of aid, the government will set it at the minimum level so as to make students indifferent towards the option of applying and not applying for the aid. Specifically,

$$a^s_{ii} = a^l_{ii} = max\big(c - I, U^R - U^H\big) = a^*_{ii}. \tag{E-9}$$

Given r^*_{ii} and a^*_{ii} above, we analyze how much welfare the scholarships and the loans create. First, suppose the government provides the scholarship with the return requirement. The maximization problem is

$$\underset{\alpha_{s1},G}{\text{Max}}\, SW(\alpha_{s1}, G|P=P_s, r=1, a=a^*_{ii}) = \alpha_{s1}[(1-\pi)(\beta\chi\mu-1)\mathbb{E}(\theta) - c + a^*_{ii}] + G \;\; s.t.$$
$$\alpha_{s1}a^*_{ii} + G = B; \quad 1 \geq \alpha_{s1} \geq 0; \quad G \geq 0 \tag{E-10}$$

Since the government budget should bind at the optimum, it follows that $\alpha^*_{s1} = min(\frac{B}{a^*_{ii}}, 1)$ and $G^* = B - \alpha^*_{s1} a^*_{ii}$. Solving the maximization problem gives

$$SW^*_{s1,ii} = \begin{cases} \frac{B}{a^*_{ii}}[(1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c] + B & \text{if} \quad B \in (0, a^*_{ii}) \\ (1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c + B & \text{if} \quad B \in [a^*_{ii}, \infty). \end{cases} \tag{E-11}$$

If the government provides the loan with the return requirement, the maximization problem is

$$\underset{\alpha_{l1}, G}{\text{Max}}\, SW(\alpha_{l1}, G | P = P_l, r = 1, a = a^*_{ii}) = \gamma_x \alpha_{l1}[(1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c + a^*_{ii}] + G \;\; s.t.$$
$$\gamma_x \alpha_{l1} a^*_{ii} + G = B; \quad 1 \geq \alpha_{l1} \geq 0; \quad G \geq 0. \tag{E-12}$$

Similarly, $\alpha^*_{l1} = min(\frac{B}{\gamma_x a^*_{ii}}, 1)$. The solution to the maximization problem is

$$SW^*_{l1,ii} = \begin{cases} \frac{B}{a^*_{ii}}[(1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c] + B & \text{if} \quad B \in (0, \gamma_x a^*_{ii}, 0)) \\ \gamma_x[(1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c] + B & \text{if} \quad B \in [\gamma_x a^*_{ii}, \infty). \end{cases} \tag{E-13}$$

Therefore, it immediately follows that the scholarship with the return requirement will be a weakly dominant policy $SW^*_{s1,ii} \geq SW^*_{l1,ii} \; \forall \; B$.

Case III.

The first observation in case $IIIa-b$ is that the government (weakly) prefers not to oblige recipients to return to the home country for each type of financial aid ($r^s_{iii} = r^l_{iii} = 0 = r^*_{iii}$). This is because the privately optimal (in the absence of financial constraints) and the socially optimal outcomes coincide. The outcomes are either R or F depending on the parameter values of $\mathbb{E}(\theta)$ and m. Therefore, for the government it is optimal not to distort the return migration decision of students and set $r^*_{iii} = 0$.

Without losing the generality, below we analyze the optimal government policy only for case $IIIa$. First, suppose that $\phi \leq \frac{2\mathbb{E}(\theta)}{c-I} - 2$. It immediately implies that $\nu^R = 0$. Suppose the government provides scholarships without the return requirement. The individual decision to apply for the scholarship without the requirement is:

$$\mathbb{1}^A(P_s, 0, a | x) = 1 \iff U^R - U^H + a \geq 0 \;\&\; a \geq c - I \; \forall \; x. \tag{E-14}$$

For case $IIIa$ it holds that $U^R > 0$. Therefore, the government will set the amount equal to $\underline{a}_{iii} = c - I$.

Hence, the government's maximization problem is

$$\underset{\alpha_{s0}, G}{\text{Max}}\, SW(G | P_s, r^*_{iii} = 0) = \alpha_{s0}[(1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - I] + G \;\; s.t.$$
$$\alpha_{s0}(c - I) + G = B; \quad 1 \geq \alpha_{s0} \geq 0; \quad G \geq 0. \tag{E-15}$$

Because the government budget constraint binds, it holds that $\alpha^*_{s0,iii} = min(\frac{B}{c-I}, 1)$. Solving the maximization problem gives

$$SW^*_{s0,iii} = \begin{cases} \frac{B}{c-I}[(1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c] + B & \text{if} \quad B \in (0, c-I) \\ (1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c + B & \text{if} \quad B \in [c-I, \infty). \end{cases} \tag{E-16}$$

Now suppose the government distributes loans without the return requirement. The acceptance of the loan is the following:

$$\begin{aligned} &\mathbb{1}^A(P_l, 0, a|x = 0) = 1 \iff U^R - U^H + a \geq 0 \;\&\; a \geq c - I \\ &\mathbb{1}^A(P_l, 0, a|x = \overline{x}) = 1 \iff U^R - U^H \geq 0 \;\&\; a \geq c - I. \end{aligned} \tag{E-17}$$

Similar to the scholarship case, it follows that the optimal amount of the loan is equal to $c - I$ and everyone will apply for the loan. The government maximizes

$$\begin{aligned} \underset{\alpha_{l0}, G}{\text{Max}}\, &SW(G|P_l, r^*_{iii} = 0) = \alpha_{l0}[(1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - I] + G \;\; s.t. \\ &\gamma_x\alpha_{l0}(c - I) + G = B; \quad 1 \geq \alpha_{l0} \geq 0; \quad G \geq 0 \end{aligned} \tag{E-18}$$

Again, $\alpha^*_{l0,iii} = min(\frac{B}{\gamma_x(c-I)}, 1)$ and the solution is

$$SW^*_{l0,iii} = \begin{cases} \frac{B}{\gamma_x(c-I)}[(1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c] + B & \text{if} \quad B \in (0, \gamma_x(c-I)) \\ (1-\pi)(\beta\chi\mu - 1)\mathbb{E}(\theta) - c + B & \text{if} \quad B \in [(\gamma_x(c-I), \infty). \end{cases} \tag{E-19}$$

Therefore, it immediately follows that the loan without the return requirement dominates the scholarship without the return requirement.

Since ν^R is a continuous function in ϕ, it follows that for moderate uncertainty levels there is $\tilde{B}^a_{iii}(\phi)$ such that for $B > \tilde{B}^a_{iii}(\phi)$, the government chooses scholarships without the return requirement and for $B < \tilde{B}^a_{iii}(\phi)$ the government chooses loans without the return requirement. After some algebra one will arrive at the following:

$$\tilde{B}^a_{iii}(\phi) = (c - I)(1 - \frac{(1-\gamma_x)\nu^R\overline{x}}{(1-\pi)(\chi\beta\overline{\mu} - 1)\mathbb{E}(\theta) - c}) \tag{E-20}$$

if $\tilde{B}^a_{iii}(\phi) > (\gamma_x + (1-\gamma_x)\nu^R)(c - I)$ and $\tilde{B}^a_{iii}(\phi) = 0$ otherwise, where ν^R is defined by equations (16) and (17). It is straightforward to see that that indeed $\frac{\partial \tilde{B}^a_{iii}(\phi)}{\partial \phi} \leq 0$.

Similar logic applies to case $IIIb$, where all of the results similarly hold.

Case IV.

There are four possible rankings of the threshold levels of the budget:

1. $\tilde{B}^I_{iv}(\phi) = \tilde{B}^{II}_{iv}(\phi) = 0$. The optimal government policy is a scholarship with the return requirement for all values of B.
2. $\tilde{B}^I_{iv}(\phi) > \tilde{B}^{II}_{iv}(\phi) = 0$. The optimal government policy is a loan with the return requirement if $B < \tilde{B}^I_{iv}(\phi)$ and a scholarship with the return requirement if $B \geq \tilde{B}^I_{iv}(\phi)$).
3. $\tilde{B}^I_{iv}(\phi) = \tilde{B}^{II}_{iv}(\phi) > 0$. The optimal government policy is a loan without the return requirement if $B < \tilde{B}^{II}_{iv}(\phi)$ and a scholarship with the return requirement if $B \geq \tilde{B}^{II}_{iv}(\phi)$.
4. $\tilde{B}^I_{iv}(\phi) > \tilde{B}^{II}_{iv}(\phi) > 0$. The optimal government policy is a loan without the return requirement if $B < \tilde{B}^{II}_{iv}(\phi)$, a loan with the return requirement if $\tilde{B}^I_{iv}(\phi) > B \geq \tilde{B}^{II}_{iv}(\phi)$, and a scholarship with the return requirement if $B \geq \tilde{B}^I_{iv}(\phi)$.

For this case, it is not clear whether the government requires recipients to return or not. This is because if the government provides loans, it holds that $\nu^F \leq \nu^R$. This follows from the fact that $m < \hat{m}$ and equations (16) and (17).

Nevertheless, one can easily argue that scholarships without the return requirement will always be an inferior policy compared to scholarships with the return requirement. Therefore, below we compare the generated social welfare of three different policies.

Assume that the uncertainty is sufficiently low. If the government provides loans without the return requirement, the maximized social welfare is:

$$SW^*_{l0,iv} = \begin{cases} \frac{B[(1-\pi)((1-m)\overline{\mu}-1)\mathbb{E}(\theta)-c-(1-\gamma_x)\nu^F\overline{x}]}{(\gamma_x+(1-\gamma_x)\nu^F)(c-I)} + B & \text{if} \quad B < (\gamma_x + (1-\gamma_x)\nu^F)(c-I) \\ (1-\pi)((1-m)\overline{\mu}-1)\mathbb{E}(\theta) - c & \\ -(1-\gamma_x)\nu^F\overline{x} + B & \text{if} \quad B \geq (\gamma_x + (1-\gamma_x)\nu^F)(c-I) \end{cases} \tag{E-21}$$

If the government provides loans with the return requirement, the maximized social welfare is:

$$SW^*_{l1,v} = \begin{cases} \frac{(1-\pi)(\chi\beta\overline{\mu}-1)\mathbb{E}(\theta)-c-(1-\gamma_x)\nu^R\overline{x}}{(\gamma_x+(1-\gamma_x)\nu^R)(c-I)}B + B & \text{if} \quad B < (\gamma_x + (1-\gamma_x)\nu^R)(c-I) \\ (1-\pi)(\chi\beta\overline{\mu}-1)\mathbb{E}(\theta) - c & \\ -(1-\gamma_x)\nu^R\overline{x} + B & \text{if} \quad B \geq (\gamma_x + (1-\gamma_x)\nu^R)(c-I) \end{cases} \tag{E-22}$$

If the government provides scholarships with the return requirement, the maximized social welfare is:

$$SW^*_{s1,iv} = \begin{cases} \frac{[(1-\pi)(\chi\beta\overline{\mu}-1)\mathbb{E}(\theta)-c}{c-I}B + B & \text{if} \quad B < c-I \\ [(1-\pi)(\chi\beta\overline{\mu}-1)\mathbb{E}(\theta) - c + B & \text{if} \quad B \geq c-I. \end{cases} \tag{E-23}$$

Therefore, the functional forms of $\tilde{B}_v^{II}(\phi)$ and $\tilde{B}_v^{I}(\phi)$ are:

$$\tilde{B}_{iv}^{I}(\phi) = (c-I)\big[1 - \frac{(1-\gamma_x)\nu^R\overline{x}}{(1-\pi)(\chi\beta\overline{\mu}-1)\mathbb{E}(\theta)-c}\big] \tag{E-24}$$

if $\tilde{B}_{iv}^{I}(\phi) > (\gamma_x + (1-\gamma_x)\nu^R)(c-I)$ and $\tilde{B}_v^{I}(\phi) = 0$ otherwise.

$$\tilde{B}_{iv}^{II}(\phi) = \frac{(\gamma_x + (1-\gamma_x)\nu^R)}{(1-\pi)(\chi\beta\overline{\mu}-1)\mathbb{E}(\theta)-c-(1-\gamma_x)\nu^R} \times \Big[(c-I)[(1-\pi)((1-m)\overline{\mu}-1)\mathbb{E}(\theta)-c)- \frac{(1-\gamma_x)\nu^F\overline{x}}{(1-\pi)(\chi\beta\overline{\mu}-1)\mathbb{E}(\theta)-c-(1-\gamma_x)\nu^F\overline{x}}\Big] \tag{E-25}$$

if $\tilde{B}_{iv}^{II}(\phi) > (\gamma_x + (1-\gamma_x)\nu^F)(c-I)$ and $\tilde{B}_{iv}^{II}(\phi) = \tilde{B}_v^{I}(\phi)$ otherwise.

Some algebra shows that indeed $\tilde{B}_{iv}^{I}(\phi) \geq \tilde{B}_v^{II}(\phi)$. Finally, it can be shown that indeed $\frac{\partial \tilde{B}_{iv}(\phi)}{\partial \phi} \geq 0$.

Two Ability Groups

The equations that induce ex-ante higher-ability students to choose the graduate school and ex-ante lower-ability ones choose the undergraduate school are the following:

$$\begin{aligned}
&I + ((1-\pi^l)\beta\overline{\mu}^g + \pi^l)\mathbb{E}(\theta^l) - c < I + \beta\overline{\mu}^u\mathbb{E}(\theta^l) - c \\
&I + ((1-\pi^l)(1-m)\overline{\mu}^g + \pi^l)\mathbb{E}(\theta^l) - c < I + (1-m)\overline{\mu}^u\mathbb{E}(\theta^l) - c \\
&I + ((1-\pi^h)\beta\overline{\mu}^g + \pi^h)\mathbb{E}(\theta^h) - c > I + \beta\overline{\mu}^u\mathbb{E}(\theta^h) - c \\
&I + ((1-\pi^h)(1-m)\overline{\mu}^g + \pi^h)\mathbb{E}(\theta^h) - c > I + (1-m)\overline{\mu}^u\mathbb{E}(\theta^h) - c.
\end{aligned} \tag{E-26}$$

Given that the conditions in 21 and 22 hold, it immediately follows that the conditions given in (E-26) are satisfied.

Proposition 4.5.

First, it is clear that if the budget is limited such that it can accommodate with financial aid at most one ability group, the government will choose the ability group that brings the highest social welfare. For the government with such a limited budget six options are available: 1) a scholarship with the return requirement to high-ability students 2) a scholarship with the return requirement to low-ability students 3) a loan with the return requirement to high-ability students 4) a loan with the return requirement to low-ability students 5) a loan without the return requirement to high-ability students 6) a loan without the return requirement to low-ability students. Providing scholarships without the return requirement (to any ability group) is always inferior to the scholarships with the return requirement.

The generated welfare for each corresponding type of policy for a government with a tight budget are the following:

$$1.\ SW_{s1}^{h,*} = \frac{(1-\pi)(\chi\beta\overline{\mu}^{g}-1)\mathbb{E}(\theta^{h})-c}{c-I}B+B \quad \text{if} \quad B^{I} < \gamma^{h}(c-I) \tag{E-27}$$

$$2.\ SW_{s1}^{l,*} = \frac{(\chi\beta\overline{\mu}^{u}-1)\mathbb{E}(\theta^{l})-c}{c-I}B+B \quad \text{if} \quad B^{I} < \gamma^{l}(c-I) \tag{E-28}$$

$$3.\ SW_{l1}^{h,*} = \frac{(1-\pi)(\chi\beta\overline{\mu}^{g}-1)\mathbb{E}(\theta^{h})-c-(1-\gamma_{x})\nu^{h,R}\overline{x}}{(\gamma_{x}+(1-\gamma_{x})\nu^{h,R})max\Big(c-I,\overline{x}-\frac{(1-\pi)(\beta\overline{\mu}^{g}-1)\mathbb{E}(\theta^{h})-c}{\nu^{h,R}}\Big)}B+B$$

$$\text{if} \quad B^{I} < \gamma^{h}(\gamma_{x}+(1-\gamma_{x})\nu^{h,R})max\Big(c-I,\overline{x}-\frac{(1-\pi)(\beta\overline{\mu}^{g}-1)\mathbb{E}(\theta^{h})-c}{\nu^{h,R}}\Big) \tag{E-29}$$

$$4.\ SW_{l1}^{l,*} = \frac{(\chi\beta\overline{\mu}^{u}-1)\mathbb{E}(\theta^{l})-c-(1-\gamma_{x})\nu^{l,R}\overline{x}}{(\gamma_{x}+(1-\gamma_{x})\nu^{l,R})max\Big(c-I,\overline{x}-\frac{(\beta\overline{\mu}^{u}-1)\mathbb{E}(\theta^{l})-c}{\nu^{l,R}}\Big)}B+B$$

$$\text{if} \quad B^{I} < \gamma^{l}(\gamma_{x}+(1-\gamma_{x})\nu^{l,R})max\Big(c-I,\overline{x}-\frac{(\beta\overline{\mu}^{u}-1)\mathbb{E}(\theta^{l})-c}{\nu^{l,R}}\Big) \tag{E-30}$$

$$5.\ SW_{l0}^{h,*} = \frac{(1-\pi)((1-m)\overline{\mu}^{g}-1)\mathbb{E}(\theta^{h})-c-(1-\gamma_{x})\nu^{h,F}\overline{x}}{(\gamma_{x}+(1-\gamma_{x})\nu^{h,F})(c-I)}B+B$$

$$\text{if} \quad B^{I} < \gamma^{h}(\gamma_{x}+(1-\gamma_{x})\nu^{h,F})(c-I) \tag{E-31}$$

$$6.\ SW_{l0}^{l,*} = \frac{((1-m)\overline{\mu}^{u}-1)\mathbb{E}(\theta^{l})-c-(1-\gamma_{x})\nu^{l,F}\overline{x}}{(\gamma_{x}+(1-\gamma_{x})\nu^{l,F})(c-I)}B+B$$

$$\text{if} \quad B^{I} < \gamma^{l}(\gamma_{x}+(1-\gamma_{x})\nu^{l,F})(c-I) \tag{E-32}$$

The budget level B^{I} stands for the initial spending of the government and $\nu^{i,j}$ denotes the probability of default for ability type $i \in \{\{h\}\{l\}\}$ and for population group $j \in \{\{R\}\{F\}\}$. The functional forms of default probabilities are as follows:

$$\nu^{h,R} = (1-\pi)max\Big(\frac{(\frac{c-I}{\beta\overline{\mu}^{g}}(\phi+2)-2\mathbb{E}(\theta^{h})}{2\mathbb{E}(\theta^{h})\phi},0\Big)+\pi\frac{(c-I)(\phi+2)-2\mathbb{E}(\theta^{h})}{2\mathbb{E}(\theta^{h})\phi} \tag{E-33}$$

$$\nu^{h,F} = (1-\pi)max\Big(\frac{(\frac{c-I}{(1-m)\overline{\mu}^{g}}(\phi+2)-2\mathbb{E}(\theta^{h})}{2\mathbb{E}(\theta^{h})\phi},0\Big)+\pi\frac{(c-I)(\phi+2)-2\mathbb{E}(\theta^{h})}{2\mathbb{E}(\theta^{h})\phi} \tag{E-34}$$

$$\nu^{l,R} = max\Big(\frac{(\frac{c-I}{\beta\overline{\mu}^{u}}(\phi+2)-2\mathbb{E}(\theta^{l})}{2\mathbb{E}(\theta^{l})\phi},0\Big) \tag{E-35}$$

$$\nu^{l,F} = max\Big(\frac{(\frac{c-I}{(1-m)\overline{\mu}^u}(\phi+2) - 2\mathbb{E}(\theta^l)}{2\mathbb{E}(\theta^l)\phi}, 0\Big) \tag{E-36}$$

Further, the following five conditions should be satisfied:

1. $SW_{s1}^{h,*} \geq SW_{l0}^{h,*}$
2. $SW_{s1}^{h,*} \geq SW_{l1}^{h,*}$
3. $SW_{l0}^{l,*} \geq SW_{s1}^{l,*}$
4. $SW_{l0}^{l,*} \geq SW_{l1}^{l,*}$
5. $SW_{s1}^{h,*} \geq SW_{l0}^{l,*}$

First, suppose for simplicity that $m = \hat{m}^S$. Since $\nu^{i,R} \geq \nu^{i,F}$, it is clear that equation 4 automatically holds. In addition, if equation 1 is satisfied, equation 2 will be also satisfied. Next, because $SW_{s1}^{h,*} > SW_{s1}^{l,*}$, there is a well defined range for the degree of uncertainty $\phi \in [\underline{\phi}, \overline{\phi}]$ for which conditions 3 and 5 hold. All five equations are satisfied if the degree of uncertainty is sufficiently high:

$$\nu^{h,R} \geq \frac{(1-\pi)(\chi\beta\overline{\mu}^g - 1)\mathbb{E}(\theta^h) - c}{(1-\pi)(\chi\beta\overline{\mu}^g - 1)\mathbb{E}(\theta^h) - c + \overline{x}}. \tag{E-37}$$

We denote the value of ϕ that breaks even equation 1 by k. The value of k is unique as the probability of the loan default is monotonic in ϕ. In addition, the ranges of parameters are well defined if $k > \underline{\phi}$.

Given that for the range existence it is necessary for low-ability students to be exposed to non-zero probability of the default, the functional form of $\underline{\phi}$ is given from the equation below:

$$\underline{\phi} = \frac{2\mathbb{E}(\theta^l) - \frac{c-I}{\chi\beta\overline{\mu}^u}}{\frac{c-I}{\chi\beta\overline{\mu}^u} - 2\mathbb{E}(\theta^l)\frac{(\chi\beta\overline{\mu}^u - 1)\mathbb{E}(\theta^l) - c}{(\chi\beta\overline{\mu}^u - 1)\mathbb{E}(\theta^l) - c + \overline{x}}}. \tag{E-38}$$

Thus, one will arrive at the condition described by equations (27) and (28).

Lastly, equation (26) is defined from the following equation:

$$\gamma^h[((1-\pi)(\chi\beta\overline{\mu}^g - 1)\mathbb{E}(\theta^h) - c] > \gamma^l[(\chi\beta\overline{\mu}^u - 1)\mathbb{E}(\theta^l) - c]. \tag{E-39}$$

Abstrakt

Rozvojové země intenzivně podporují vzdělání a to tak, že studentům poskytují finanční prostředky pro studium v zahraničí. Zatímco některé země poskytují finanční podporu studentům ve formě grantů a stipendií, jiné se spíše přiklání k metodě studentských půjček. Tato práce používá informace z nového souboru dat, který popisuje charakteristiky vládních programů z celého světa, které se zaměřují na studentská stipendia a půjčky, které slouží jako prostředek pro finanční pomoc studentům při studiu v zahraničí. Tato data nám umožňují identifikovat jedinečná fakta o těchto politických programech v rozvojových zemích. Výsledky ukazují, že v porovnání s metodou studentských půjček, jsou do stipendijních programů mnohem častěji vybírání studenti na základě svých dovedností. Zároveň se stipendijní programy zaměřují více na bakalářské a magisterské studium, a také po studentech častěji požadují návrat do domovské země. Ve své práci jsme zkonstruovali studentsko-migrační model pro dvě země s vládními zásahy, který kvalitativně bere v úvahu zákonitosti, které jsme vypozorovali v datech. V našem modelu jsou zásahy vlády oprávněné a to ze dvou důvodů. Zaprvé, studenti z rozvojových zemí jsou finančně omezeni a nemohou si tedy dovolit vzdělání v zahraničí. Za druhé, stát si váží produktivity svých pracovníků jež se vrátili ze svých studií v zahraničí mnohem více než trh. Ve své práci argumentujeme, že v prostředí, ve kterém si studenti nejsou jisti svou budoucí produktivitou a čelí riziku neúspěchu při svých studiích, mohou stipendia sloužit jako nástroj pro pojištění se proti potenciálnímu krachu. Z analýzy vyplývá, že v případě, kdy je očekávaná kvalita studentů proměnlivá, bude stát s malým rozpočtem v určitých případech poskytovat stipendia studentům s vyšší očekávanou kvalitou, přičemž od nich bude po ukončení studií požadovat návrat do domovské země a půjčky studentům s nižší očekávanou kvalitou. Po studentech, kterým poskytne stát půjčku, nebude vyžadovat návrat na domovské země.

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